VERIFICATION OF TRANSLATION

I, Stephan Bamberger, a citizen of the Federal Republic of Germany, of Grubesallee 26, 22143 Hamburg, do hereby declare that I am well acquainted with the English and German languages, and that I am the translator of the documents attached and certify that the following is a true and correct translation of the original priority document (European Patent Application No.03090031.0) to the best of my knowledge and belief.

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Stephan Bamberger

Dated this 15th day of August 2006

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The attached documents are exact copies of the European patent application described on the following page, as originally filed.

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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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Storage device with variable storage capacity

Description

The invention is concerned with a storage device with variable storage capacity, in particular for storing rod-shaped products, with an input area, an output area and also a continuous conveying element connecting the input area to the output area, in such a way that the store operates on the principle of "first in – first out" (FiFo store), the conveying element, which is guided by means of guide elements in a loop from the input area to the output area, having a multi-layered storage area, normally provided with products, namely a so-called full strand, and a multi-layered return area, normally free of products, namely a so-called empty strand, the two areas being compensated in length, depending on the state of fullness of the store, in such a way that the overall length of the conveying element is constant.

Stores of this kind are used in particular in the domain of the tobacco-processing industry and connect production machines, e.g. a cigarette-making machine – also designated below as a "maker" – to a cigarette-making machine – also designated below as a "packer". The task of the store is to bridge short stoppage times of the maker or packer without the entire production line having to be halted, so continuous production is guaranteed. During operation of the production line the state of fullness of the store changes as a function of breakdown or stoppage times of individual components. In the event that e.g. the packer, which is arranged downstream of the store, breaks down, the store fills to a storage maximum in that the length of the full strand increases with simultaneous shortening of the empty strand. If the maker connected upstream of the store breaks down, operation of the production line is maintained at least temporarily in that the packer receives the products from the store until the storage minimum has been reached. Owing to the constant release of products from the store – with a simultaneous lack of delivery of products into the store – the length of the full strand is reduced, while the length of the empty strand lengthens correspondingly, so the overall length of the circulating conveying element is therefore always constant. The conveying element is therein wound in a loop to create as long as possible a storage or transport path.

In a known storage device the full strand and the empty strand are arranged above one another, i.e. in different planes from one another. Therefore two guide elements necessary for

guiding and reversing the conveying element are needed in each case both for the full strand and for the empty strand. The conveying element also has to be steered from the lower to the upper plane and back, requiring additional structural outlay. On the one hand this has the disadvantage that the known store has a great overall height, making it difficult or completely impossible to use, especially in factory halls with a low ceiling height. On the other hand maintenance or servicing of a storage device of this kind is very complicated, as individual parts are sometimes difficult to access. Furthermore, the known store has a great multiplicity of parts, leading to high manufacturing costs.

The same applies to a further known storage device in which the full strand and the empty strand are basically arranged side by side. However, the full strand and the empty strand superimpose one another or cross one another in the area of a common guide element, so that the full strand and the empty strand are arranged above one another at least in the area of the common guide element. This has, on the one hand, the disadvantage that the overall height of the known storage device is considerable and, indeed, is conditional on layering, either in blocks or alternately, of the individual windings of the full strand and the empty strand in the area of the common guide element. On the other hand, the known structure requires a multiplicity of reversals or reversing devices, leading to a great multiplicity of parts.

It is therefore the object of the present invention to create an economical and technically simple store which safely and reliably guarantees the transport of sensitive products.

This object is achieved by the initially mentioned store with the features of the preamble of claim 1 in that the full strand and the empty strand are arranged side by side in a common horizontal plane, wherein to each layer of the full strand is allocated a corresponding layer of the empty strand in the same plane. In this way, on the one hand, a compact store is created which has a small overall height, as a "multi-storey" structure is avoided. The constructional size is also reduced in relation to the length of the store owing to the interleaved structure of the full strand and the empty strand in comparison to the known solutions, yet with the same storage capacity. The loop-type guiding of the full strand, on the one hand, and the meander-shaped guiding of the empty strand, on the other hand, enable a reduction in the dimensions of the store in a particularly efficient and simple way. On the other hand, the configuration of the store according to the invention also achieves an appreciable reduction in parts, which, on the one hand, lowers manufacturing costs and, on the other hand, reduces maintenance

expenditure. A particular advantage of the store according to the invention is that the running direction of the conveying element can be freely chosen, so the multiplicity of layouts, and therefore the range of use for this store, is increased. By allocating one layer of the full strand and of the empty strand in one plane in each case, crossings over of the individual areas of the conveying element are additionally avoided, increasing the safety and reliability of the store.

In a preferred embodiment of the invention the movable plate towers of the empty strand and the movable disc tower of the full strand are arranged on a common slide and movable as a unit. By this feature, particularly simple and stable guiding of the plate towers and the disc tower can be guaranteed, a reduction in parts being achieved by the commonly used slide.

Advantageously, the plates of the plate towers have a considerably smaller diameter than the storage discs of the disc towers. This enables further reduction of the constructional size of the store in length in a simple manner, especially as even more effective interleaving of the full strand with the empty strand is achieved, since the plates are constructed smaller than the storage discs.

A further development of the invention shows a store in which a stationary inlet disc is arranged above the disc towers and an outlet disc is arranged below the stationary disc tower. The inlet disc and the outlet disc simplify the filling or emptying of the store. in particular if the diameter of the inlet disc is greater than the diameter of the outlet disc and the diameter of the outlet disc is greater than the diameter of the storage discs. In this way, namely, two additional vertical planes emerge, one of which serves as input and the other as output plane. The positioning of the input and output points can therefore be freely chosen, which again increases the flexibility of the layout.

In a further preferred configuration of the store according to the invention all the spindles of the plate towers and the disc towers are supported in each case on both their ends. By avoiding floating bearings. the stability of the storage device is increased, reducing the susceptibility to breakdown and therefore maintenance expenditure and also enabling a simpler method of construction, as the bearing points of the spindles are virtually moment-free.

A tensioning device for the conveying element is preferably provided in the area of the empty strand. In combination with the arrangement of the full strand and the empty strand in one

plane, only low friction forces have to be overcome in order to tension the conveying element by traction on the conveying element itself, in particular in the area of the empty strand.

Further preferred embodiments and features of the store according to the invention emerge from the subordinate claims and the description. A particularly preferred embodiment of the store is explained in greater detail using the drawings.

Fig. 1 shows a perspective front view of an embodiment of the storage device according to the invention from diagonally above,

Fig. 2 shows a perspective rear view of the storage device according to Fig. 1 from diagonally above,

Fig. 3 shows a perspective front view of the storage device according to Fig. 1 from diagonally below,

Fig. 4 shows a schematic illustration of the storage device in horizontal projection,

Fig. 5 shows a schematic illustration of the storage device according to Fig. 4 in side view,

Fig. 6 shows a rear view of the storage device according to Fig. 1;

Fig. 7 shows a detail, namely the tensioning device, of the storage device according to Fig. 1 in enlarged illustration.

The storage device described below serves as linking element between a first (not illustrated) cigarette-making machine, the maker, and a second (not illustrated) cigarette-packing machine, the packer. The storage device is suitable in particular for conveying and storing cigarettes in a self-contained maker/packer connection, a so-called hard link. However, other methods of use for the storage device described are also possible.

The storage device 10 (also designated below as store) has a basic frame 11, formed from two elongated longitudinal profiles 12, 13 and several cross-profiles, the traverses 14, for connecting the longitudinal profiles 12, 13, located parallel opposite one another. The traverses 14

serve simultaneously to stiffen the basic frame 11. Arranged on a front end 15 of the basic frame 11 is a carrying arm 16. The carrying arm 16, seen from the side, is formed as L-shaped. A free side 17 of the carrying arm 16 extends substantially parallel to the longitudinal profiles 12, 13. In the area of the front end 15 a floor-plate 18 is mounted between the longitudinal profiles 12, 13, this being substantially parallel and distanced from the side 17.

Between the longitudinal profiles 12, 13 are two disc towers 19, 20. One of the disc towers 19, advantageously the one located in the area of the front end 15, is constructed as stationary. Disc tower 19 is formed from several storage discs 21 arranged above one another, all arranged as rotatable on a common vertical spindle 22. The spindle 22 is supported on both sides, namely in the floor-plate 18 and in the side 17. The number of storage discs 21 depends on the desired maximum storage capacity of the storage device 10. With each additional storage disc 21 a new plane is generated, once again leading to an increase in the maximum storage capacity. Below the stationary disc tower 19 an outlet disc 23 is additionally arranged. The outlet disc 23 is likewise arranged as rotatable on the spindle 22. Normally the diameter of the outlet disc 23 is greater than the diameter of the storage discs 21, so the outlet disc 23 has a projection A in respect of the storage discs 21. Alternatively or cumulatively the centre point 24 of the outlet disc 23 can also be offset from the centre point 25 of the storage discs 21. For this purpose the spindle 22 is then constructed in steps, so the centre or rotation points 24, 25 are different.

The other disc tower 20, arranged adjacent to disc tower 19, is constructed as movable relative to disc tower 19. Disc tower 20 likewise has several storage discs 26 arranged above one another, all arranged as rotatable on a common vertical spindle 27. The number of storage discs 26 corresponds to the number of storage discs 21. The spindle 27 is supported on both sides in a mobile slide 28. For this purpose the slide 28 has a cover-plate 29 and a base-plate 30. Plates 29 and 30, advantageously constructed as triangular, are arranged as horizontal and parallel at a distance from one another. At least the base-plate 30 is guided on two opposite sides in and/or on linear guides 31, 32. This makes the slide 28 as a whole movable in the longitudinal direction of the longitudinal profiles 12, 13, this being in a one-dimensional direction parallel to longitudinal profiles 12, 13.

Additionally arranged on the slide 28 are two plate towers 33, 34. The plate towers 33, 34 are identically constructed and in each case have a number of plates 35 or 36. The plates 35 or 36

are arranged in each case as rotatable on a vertical spindle 37 or 38. The number of plates 35 or 36 on each spindle 37 or 38 corresponds to the number of storage discs 21 or 26 on spindles 22 or 27. For example, the movable disc tower 20 can have six storage discs 26 for forming six storage planes. Corresponding to this, the stationary storage tower 19 likewise has six storage discs 21. The plate towers 33, 34 in the example mentioned likewise have six plates 35, 36 in each case. The plates 35, 36 have a considerably smaller diameter than the storage discs 21, 26. The diameters of the storage discs 21, 26 are preferably greater by a multiple than the diameters of the plates 35, 36. Advantageously the diameters of the storage discs 21, 26 are at least double the size of the diameters of the plates 35, 36.

Above the disc towers 19, 20 (in Fig. 1) is an inlet disc 39. The inlet disc 39 is arranged on a vertical spindle 40. The spindle 40 is supported as floating on the free end 41 of the side 17. The diameter of the inlet disc 39 is greater than the diameter of the outlet disc 23, so a projection B arises. Advantageously, projections A and B come to approximately 300 mm. However, other values can be chosen for projections A and B. In alternative embodiments the outlet disc 23 can also be greater in diameter than the inlet disc 39. However, both the inlet disc 39 and the outlet disc 23 are preferably greater in diameter than the storage discs 21, 26. Furthermore, there is also the possibility that the outlet disc 23 is arranged above the disc towers 19, 20, while the inlet disc 39 is located below the disc towers 19, 20.

On the front end 42 of the store 10 opposite the carrying arm 16 vertical frames 45, 46 are arranged on both open ends 43, 44 of the longitudinal profiles 12, 13. Frame 45, which, advantageously but not necessarily, is arranged on the side of the store 10 on which there are an input area 47 and an output area 48 of the store 10, serves on the one hand to support a vertical spindle 49, which is supported with one end on frame 45 and with the other end on longitudinal profile 12. On the spindle 49 two plates 50 are rotatably supported. Additionally, several reversing rollers 51 are arranged above one another on the frame 45. The reversing rollers 51 are rotatably mounted in each case on a horizontal spindle 52. The number of reversing rollers 51 depends on the number of planes formed by the plates 35, 36 or storage discs 21, 26. The plates 50 are arranged above or below the reversing rollers 51 and quasi form a frame round them.

Frame 46 on longitudinal profile 13 is likewise constructed to accommodate reversing rollers 53 and serves as tensioning device 54. The reversing rollers 53 are rotatably mounted in each

case on a horizontal spindle 55. The spindles 55 are arranged as fixed on a tensioning bar 56, which is guided as linearly movable inside frame 46. A weight 58 for tensioning the chain 63 is attached to the tensioning bar 56 via a rope 57 or similar. The rope 57 is guided over a reversing roller 59. The tensioning of the chain 63 can, however, be adjusted in some other customary way, e.g. by spring force, via pneumatic or hydraulic devices or similar.

On both sides of the store 10 vertical struts 60 are mounted on the longitudinal profiles 12, 13. The struts 60 serve to hold guide sheets 61. The guide sheets 61 are flat metal sheets extending linearly and extending virtually over the entire length of the longitudinal profiles 12, 13. Several guide sheets 61 are arranged above one another on each side of the store 10. The number of guide sheets 61 depends on the number of planes of the store 10 defined by the number of plates 35, 36 or storage discs 21, 26.

The store 10 has a continuous chain 63 as conveying element 62. The chain 63 has a constant length and is guided in the manner of a loop, starting from the input area 47, to the output area 48, round the inlet disc 39, the storage discs 21, 26, the plates 35, 36, the reversing rollers 51, 53, the plates 50 and the outlet disc 23. The chain 63 is constructed for accommodating rod-shaped products, in particular cigarettes, filters, etc., which lie on it with their longitudinal extension crosswise to the direction of transport of the chain 63. The chain 63 is guided in several planes in an oval shape, the reversing points being formed by the revolving storage discs 21, 26 and the inlet disc 39 and the outlet disc 23. In order to guide the chain 63 from one plane to the next, the storage discs 21, 26, the inlet disc 39 and the outlet disc 23 are constructed as inclined. Advantageously, the inclination is approximately 3.5° to the spindles 19 or 27. The inclination is advantageously achieved by a "crooked" bore in the storage discs 21, 26, the inlet disc 39 and the outlet disc 23. In a further embodiment the plates 35, 36 are also constructed as inclined, this likewise being by a "crooked" bore and by the same amount of angle of approximately 3.5° as the storage discs 21, 26. In this way, in particular guiding of the chain between the plates 35, 36 is simplified, so the load on the chain can be lessened owing to reduced friction losses. The angle of inclination can, however, also be greater or smaller than 3.5°.

The conveying element 62 or the chain 63 is substantially divided into two areas, namely on the one hand into the full strand 66, occupied by products during operation, with its stationary disc tower 19 and its disc tower 20 which changes in location, and on the other hand into the

empty strand 67, product-free during operation, with its two plate towers 33, 34 which change location and two stationary reversing stations, formed by the reversing rollers 51 or 53 arranged on the frames 45, 46. The full strand 66 and the empty strand 67 lie completely side by side in a common plane. The full strand 66 and the empty strand 67 therein have in each case separate guide elements which can also be different from one another. The guide elements of the full strand 66 are formed by the disc towers 19, 20. The guide elements of the empty strand 67 comprise the plate towers 33, 34 and also the reversing rollers 51, 53.

The chain areas of the full strand 66 and the empty strand 67 behave in complementary manner to one another, i.e. lengthening of the full strand 66 is at the cost of the length of the empty strand 67, and vice versa. In the area of the full strand 66 the chain 63 is wound round the disc towers 19, 20 in an oval shape. In the area of the empty strand 67 a meander-shaped course of the chain 63 arises, owing to the plate towers 33, 34 and the reversing rollers 51, 53. To each loop or layer of the full strand 66 a loop or layer of the empty strand 67 is allocated in the same plane. In this way the loops of the full strand 66 and the empty strand 67 located in the same plane can also use the same guides formed by the guide sheets 61.

In the layout shown in Fig. 1, as already alluded to above, the input area 47 and the output area 48 are arranged on the same side of the store 10. Conditional on projection A or B of the output disc 23 or the inlet disc 39, different vertical planes emerge for the input or output of the products into the store 10. In the embodiment example shown the input area 47 is above the storage discs 21, 26, while the output area 48 is below the storage discs 21, 26. This makes free positioning of the input and output points along a straight line possible, without loading the product with additional reversals of the mass flow. The choice of input and output height can also be freely chosen. Even the running direction of the chain 63 can be reversed. Besides the layout shown, any layouts can therefore be produced without great expenditure for changing or can be adapted to specific customer desires. For example, there is the possibility of arranging the input area 47 and the output area 48 on different sides of the store 10 or both areas 47 and 48 on the other side from that chosen in the embodiment example shown.

A first drive 64 for the chain 63 is arranged in the input area 47. A second drive 65, also for the chain 63, is mounted in the output area. The drives 64, 65 are connected to a common control unit. The control unit enables automated compensating of the lengths of the full strand 66 and the empty strand 67 as a function of the difference in speed of the drives 64, 65. In

other words the difference in speed between the input area 47 and the output area 48 automatically effects a movement of the slide 28. At the same speed of both drives 64, 65 the store 10 is in a quasi stationary state. If the speed in the output area 48 is greater than in the input area 47, the full strand 66 is shortened with corresponding lengthening of the empty strand 67. If the speed in the input area 47 is greater than in the output area 48, the empty strand 67 shortens with corresponding lengthening of the full strand 66.

The store 10 can be constructed as a floor version. This means that the store 10 is mounted directly on the machines connected upstream and/or downstream or on a stanchion configuration. A version of this kind offers advantages in the elimination of breakdowns and maintenance. The storage planes are therein above the make/pack combination, guaranteeing the required through heights. The store 10 can, however, also be used as a ceiling version. The latter version has a very small area requirement and short paths.

The principle of the store 10 is described below. The mass flow, normally consisting of cigarettes lying crosswise on the chain 63, is – starting from the maker – inserted on the chain 63 in the input area 47 via the input disc 39 into the store 10 and guided continually through the variable storage loop consisting of full strand 66 and empty strand 67 according to the principle of first in – first out. The length of the storage loop depends on the desired maximum state of fullness of the store. The mass flow is transported on the chain 63 in serpentine shape, in other words following the course of the chain 63, round the inlet disc 39 and the storage discs 21, 26 and the outlet disc 23 from the input area 47 to the output area 48 and there passed to the packer. Because of the inclination of the inlet disc 39 and the storage discs 21, 26 the chain 63 is guided from one plane to the next. Advantageously, the store 10 has a minimum state of fullness, so the packer is supplied with cigarettes from the store 10 if there is a stoppage of the maker. Owing to removal of the cigarettes from the store 10, - at greater speed of drive 65 than of drive 64 – the length of the full strand 66 lessens, while the length of the empty strand 67 – with constant overall length of the chain 63 in the overall system – is increased, in that the slide 28 or the movable disc tower 20 moves in the direction of the stationary disc tower 19. If the storage minimum has been reached, the packer must be stopped until a preset minimum state of fullness has been reached again.

When the packer has been stopped the state of fullness of the store increases, as the cigarettes are conveyed from the maker into the store 10. In this way the full strand 66 increases, in that

the movable disc tower 20 moves away from the stationary disc tower 19. Simultaneously, the length of the empty strand 67 lessens until the storage maximum has been reached. As a special mode of operation, the separation of faulty cigarettes from the mass flow by gradual removal of the cigarettes in the area of the input area 47 is additionally preferred.

Claims

1. Storage device with variable storage capacity, in particular for storing rod-shaped products, with an input area (47), an output area (48) and a continuous conveying element (62) connecting the input area (47) to the output area (48), in such as way that the store (10) operates on the principle of "first in – first out" (FiFo store), the conveying element (62), which is guided by means of guide elements in a loop from the input area (47) to the output area (48), having a multi-layered storage area, normally provided with products, namely a so-called full strand (66), and a multi-layered return area, normally product-free, namely a so-called empty strand (67), the two areas being compensated in length depending on the state of fullness of the store (10), in such a way that the overall length of the conveying element (62) is constant, characterised in that the full strand (66) and the empty strand (67) are arranged side by side in a common horizontal plane, wherein to each layer of the full strand (66) is allocated a corresponding layer of the empty strand (67) in the same plane.

2. Store according to claim 1, characterised in that the full strand (66) and the empty strand (67) have separate guide elements in each case.

3. Store according to claim 1 or 2, characterised in that the guide elements in the area of the full strand (66) are formed from two disc towers (19, 20), which have several storage discs (21, 26) in each case, arranged as rotatable on a vertical spindle (22, 27), the disc towers (19, 20) being movable relative to one another, in such a way that a first disc tower (19) is constructed as stationary and the second disc tower (20) as movable linearly to the first disc tower (20) in a horizontal plane.

4. Store according to one of claims 1 to 3, characterised in that the guide elements of the empty strand (67) are formed from two plate towers (33, 34) which in each case have several plates (35, 36) arranged as rotatable on a vertical spindle (37, 38), the plate towers (33, 34) being constructed as movable linearly in a horizontal plane.

5. Store according to claim 4, characterised in that the movable plate towers (33, 34) of the empty strand (67) and the movable disc tower (20) of the full strand (66) are arranged on a common slide (28) and movable as a unit.

6. Store according to claim 4 or 5, characterised in that the plates (35, 36) have a considerably smaller diameter than the storage discs (21, 26).

7. Store according to one of claims 4 to 6, characterised in that in the area of the empty strand (67) additionally to the plate towers (33, 34) a number of stationary reversing rollers (51, 53), which are rotatable in each case on a horizontal spindle (52, 53), are arranged as guide elements, the number of reversing rollers (51, 53) depending on the number of storage discs (21, 26) or plates (35, 36).

8. Store according to one of claims 1 to 7, characterised in that the conveying element (62) is constructed as a continuous chain (63).

9. Store according to one of claims 1 to 8, characterised in that a drive (64, 65) for the conveying element (62) or the chain (63) is arranged in each case in the input area (47) and the output area (48) of the store (10).

10. Store according to one of claims 3 to 9, characterised in that above the disc towers (19, 20) an inlet disc (39) and below the stationary disc tower (19) an outlet disc (23) is arranged, the diameter of the inlet disc (39) being greater than the diameter of the outlet disc (23) and the diameter of the outlet disc (23) being greater than the diameter of the storage discs (21, 26).

11. Store according to claim 10, characterised in that at least the storage discs (21) of the stationary disc tower (19) and the inlet disc (39) and the outlet disc (23) are inclined to a horizontal plane.

12. Store according to one of claims 4 to 11, characterised in that all the spindles (22, 27, 37, 38) of the disc towers (19, 20) and the plate towers (33, 34) are supported in each case on both their ends.

13. Store according to one of claims 8 to 12, characterised in that the conveying element (62) or the chain (63) is guided along the longitudinal sides of the store (10) on both sides by guide sheets (61).

14. Store according to one of claims 1 to 13, characterised in that the lengths of the full strand (66) and the empty strand (67) and therefore the storage capacity of the store (10) are automatically changeable by means of the difference in speed between the drive (64) in the input area (47) and the drive (65) in the output area (48).

15. Store according to one of claims 1 to 14, characterised in that in the area of the empty strand (67) a tensioning device (54) for the conveying element (62) or the chain (63) is provided, the tensioning device (54) being formed from a frame (46), a tensioning bar (56), a weight (58), a rope (57), a tensioning roller and also a reversing roller (59).

Abstract

The invention relates to a storage device with variable capacity, the storage device having as conveying element a full strand, normally occupied by products, and a product-free empty strand. The full strand and the empty strand are compensated depending on the state of fullness of the storage device, the overall length of the conveying element being constant.

In known storage devices the empty strand and the full strand are either arranged above one another or they cross one another in the area of a common guide element, so they are arranged above one another at least in the area of the common guide element. This means that the known devices have a large overall height and a multiplicity of parts.

The object of the invention is to create an economical and technically simple store which safely and reliably guarantees the transport of sensitive products. The object is achieved in that the full strand and the empty strand are arranged side by side in a common horizontal plane, wherein to each layer of the full strand is allocated a corresponding layer of the empty strand in the same plane.

in connection with Fig. 1